AEROSPACE & MECHANICAL ENGINEERING

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UNIVERSITY OF NOTRE DAME, NOTRE DAME, INDIANA 46556

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SPEAKER: **Professor Xueying Deng**
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Beijing University of Aeronautics and Astronautics
Beijing, China

TOPIC: **ACTIVE CONTROL OF ASYMMETRIC VORTICES-INDUCED WING-ROCK USING MICRO TIP PERTURBATION**

DATE: Tuesday, February 19, 2013

TIME: 3:30 p.m.

PLACE: Lower Level Auditorium, Geddes Hall

RECEPTION: 3:00 – 3:30 p.m. – Coffee House, Geddes Hall

ABSTRACT

Wing-rock refers to an oscillating rotary motion of aircraft induced by asymmetric vortices over wing/body configurations during flight at high-angles-of-attack. Successful control of the wing-rock motion is critical in ensuring flight safety at the high-angles-of-attack regime. In this talk, I will describe an experimental investigation about a novel active control method that can effectively suppress or even eliminate the wing-rock motion using perturbations introduced by a micro bump installed near the nose tip of the wing/body configuration.

Free roll oscillation patterns of two wing/body configurations with low and high wing swept angles are investigated for angles of attack varying from low to high to document the effect of the perturbations from a micro bump located at a variety of circumferential locations near the nose tip. The results of the low swept wing model show that the wing rock motion patterns are strongly dependent on the circumferential position of the micro-perturbation near the nose tip of the model. Three types of free roll oscillation patterns are identified, including (a), the limit cycle wing rock at $\theta=0^\circ$ or 180°, with θ being the circumferential angle of the micro-perturbation from the wind ward symmetric surface, (b), the irregular oscillation at $\theta=90^\circ$ or 270° and (c), the tiny roll oscillation pattern for θ located at other circumferential positions. For the low swept wing model, a technique of suppressing wing rock by rotating the nose tip perturbation at frequencies higher than that of the free roll oscillation is introduced. It is shown that increasing the frequency of the rotating micro-perturbation significantly enhances the effect of suppression of the free wing-rock motion.

For the model with high swept wing, a different perturbation control technique is developed for suppression of the wing rock. This technique utilizes two pairs of asymmetric vortices, with one pair from the forebody and the other from the high swept wing, to control the wing rock. It is found that when the two pairs of asymmetric vortices are in phase, the wing rock appears to be stronger. However, when the two pair asymmetric vortices are in counter phase, achieved by adjusting the circumferential location of the micro perturbation at the nose tip, the amplitude of the wing rock is significantly reduced.

NOTE: ***If you are interested in meeting individually with Dr. Deng, please contact Linda at 631-5431***